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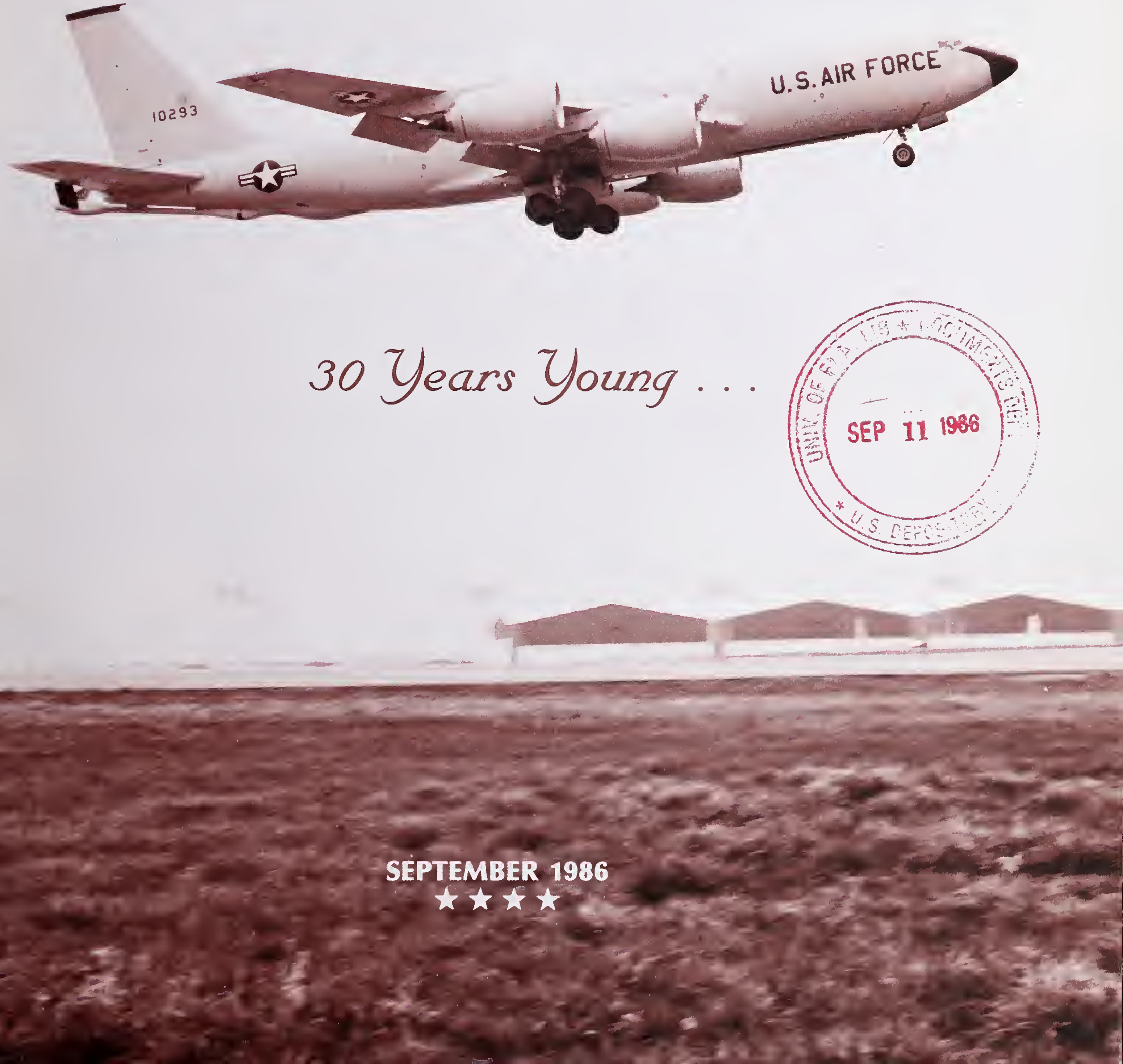
Combat Crew

strategic air command



30 Years Young . . .

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AIR REFUELING: Keystone To Global Deterrence

Air refueling is the backbone of strategic and tactical force projection throughout the world. As the sole manager of air refueling assets, SAC is responsible for operations that literally hold the key to worldwide airpower capability. Through the years significant insight has been gained using air refueling assets more effectively. However, despite improvements in technology, we are just as dependent on this capability as ever. The changing world climate, since air refueling became "routine," has also increased our reliance on air refueling: In short, air refueling forms the basis for our planning, force structure and force deployment.

The concept of aerial refueling is relatively new when compared with aviation related warfare. Combat aircraft were first used for observation, then pursuit and by the end of World War I, crude hand held bombs were dropped "over the side." It wasn't until 27 June 1923 that Lieutenants Lowell H. Smith and John P. Richter made air refueling a reality. The practicality of air refueling was demonstrated to the world in January 1929 when Major Carl A. Spaatz, Capt Ira C. Eaker, Lt Harry A. Halvorson, Lt Elwood R. Quesada and SSgt Roy R. Hooe made a 150-hour, 40-minute flight in an air refueled Fokker C-2, the "Question Mark." However, it didn't become an operational reality until a KB-29 was used to refuel the "Lucky Lady" during the first trans-world nonstop flight on 2 March 1949. The United States now had global airpower without relying on foreign bases.

Air refueling's first general use was by SAC. As the Command needed the long-range operation permitted by air refueling, hence we became the manager. Though the usefulness of this capability has been realized by the tactical force operators and more recent airlifters, we have maintained our role as the air refueling "OPR." Our strategic deterrence function requires it.

As the USAF single manager for air refueling, we gained proficiency in air refueling as our experience level increased. From a single type of rendezvous in conjunction with a long straight track, we've branched out to about a half dozen types of rendezvous and numerous varieties of tracks and anchors. We've "fine-tuned" our planning, extracting the most capability from the least assets.

To illustrate our increased use of tanker resources, consider that the KC-135's availability has decreased 20 percent the last 20 years while the number of air refuelings has increased 400 percent. The addition of a total of 60 KC-10s and the "E" and "R" model conversions will alleviate the shortage to a degree. The bottom line — more efficient tanker use is mandatory. Much of our knowledge regarding air refueling was gained in Southeast Asia, from combat sorties and noncombat ferry operations. We attained better use as a result of improved maintenance and operations; this follows the "work smarter" trend.

In the near term, technology will not decrease our tanker dependency. Despite the development of more fuel efficient engines and airframes, the fact remains that because of runway and operational constraints, any airplane has a maximum weight at which it can get airborne. We will always be able to extract more range or carry a heavier bomb load if we can air refuel enroute. Tactical aircraft technology has made large strides in producing more efficient power plants. But to remain competitive in the combat arena, designers have had to increase thrust, practically negating increased fuel efficiency. Thus, although technology has given us some very great advances in aircraft, the fact remains we dramatically improve our combat capability through air refueling.

After the turn of the century, when the United States found itself as an emerging world power, we had almost unlimited use of other nations' ports and later, airfields. That situation began to change after WW II. The rapidly evolving world situation led many nations to assert their independence. Many nations no longer wanted our offensive weapons based in their country and this trend has continued to the present. Where we once had bases spread throughout the world, we now are limited to a relative handful of locations. To project airpower throughout the world, we must have adequate air refueling capability. Recent events in the Middle East have borne this out. When the United States was unable to overfly France and Spain enroute to Libya, we were forced to take a very circuitous route. The mission wouldn't have been difficult without air refueling; it would have been impossible! Although carrier-based aircraft can sometimes handle part of the mission, they are limited in number and may not be time responsive, depending on location. There is just no denying the fact the world geopolitical situation requires the use of air refueling if we want worldwide deterrent capability.

Air refueling is an integral part of our combat planning and operations — not an option. I see this daily while reviewing our Eighth Air Force missions. Most of our sorties simply wouldn't be effective without it. In fact, some might as well not launch. Whether it's a RED FLAG, ORI, GLOBAL SHIELD, reconnaissance, VOLANT BOOM, or combat sortie, our air refueling capability increases combat capability and flexibility. Those of us in the Strategic Air Command have a big responsibility to insure the Air Force has the best possible air refueling capability. The people of SAC have done this job well. We must not relax but rather redouble our efforts toward improved air refueling operations, maintenance, safety, and tactics. Air refueling truly is the keystone to worldwide deterrence because it so greatly increases our combat capability. It's too important a job to be done at less than your professional best, because in the world combat arena there is "no second place victor."★★★

Lt Gen Kenneth L. Peek, Jr.
Commander, Eighth Air Force

FLARE

Combat Crew

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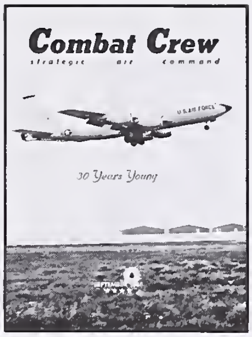

Combat Crew

strategic air command

30 Years Young

ON OUR COVER

August 31 marked the 30th Anniversary of the KC-135A. This KC-135R is the latest of 46 versions developed by the U.S. Air Force. For more on the KC-135 "family tree" see page 4.

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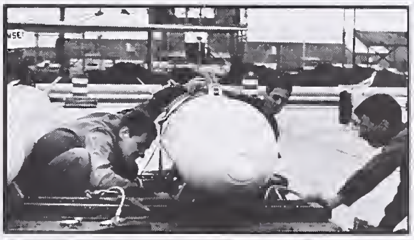
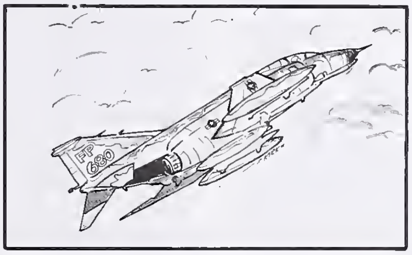


1986 SAC Loading Comp 14



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Next Month . . .

A tribute to a "man with a mission."

The Plane of a

A. T. Lloyd
Editor, Boeing Airliner Magazine

August 31, 1986 marks the 30th anniversary of the first flight of the Boeing KC-135A Stratotanker. Few military aircraft production programs undertaken since the end of WWII can compare with the KC-135 in size, speed of execution, cost effectiveness and operational success.

Between April 30, 1957 and January 12, 1965, a total of 820 of these airplanes were manufactured at the Renton, Washington, plant. Built at an average rate of seven a month throughout that period, these aircraft were delivered to the U.S. Air Force at the lowest cost per pound of airframe weight of any military aircraft then in production in the United States. The production rate peaked at 15 aircraft a month between June 1958 and July 1959 and when Boeing completed delivery of the last of the KC-135s at the beginning of 1965, it was able to announce that the production value of the 820 aircraft built was about $1.66 billion, or some $2 million per copy.

The USAF certainly has had value for its money. The Stratotanker force is managed by SAC but has responsibilities far beyond the operational support of SAC's own strategic bombers. KC-135As also serve the fighters of Tactical Air Command, the transports of Military Airlift Command and aircraft of the U.S. Navy and Marine Corps, and NATO air forces in Europe. Included in this force are a number of units manned by the Air National Guard, these units sharing with the regular squadrons in maintaining the Tanker Task Forces that are deployed at various bases around the world to support specific operational missions on a regular or transient basis.

Of the total production quantity of 820 of the Boeing jet tanker family, no fewer than 732 were built to a common standard (subject to the usual progressive introduction of production-line modifications) as KC-135As. Such consistency was itself unusual for so long a production run of a multi-engined aircraft, but it has been more than offset by the extent to which subsequent modifications programs have produced distinctive variants. Apart from the KC-135A, six other designated variants came off the production line, but the -135 family has subsequently grown to a current total of 46 variants that are identifiable by prefix and suffix letter designations, with a number of subvariations within certain series. The family lineage of the -135s is depicted on the chart on page six.

Boeing has had an interest in aerial refueling since 1929 when a hose was extended from a Boeing Model 40-B to service a Model 95 mailplane with fuel. The first flying boom was developed by Boeing for use on the KB-29P in the late 1940s. A total of 116 B-29s were converted to boom tankers. Next came a fleet of 814 KC-97 propeller-driven Stratofreighters with an improved boom system. With the large influx of jet bombers into SAC's inventory, the need for an all-jet tanker was evident. Boeing conducted a number of design studies based on the KC-97 (Boeing Model 367), eventually leading to the Model 367-80 — a four-jet, swept-wing airplane. The Dash 80 first flew on July 15, 1954, concurrent with Boeing's 38th anniversary. By October of that year the USAF had placed an order for 29 airplanes based on the Dash 80 even before the design had been finalized or the inflight refueling capabilities of the airplane had been demonstrated. The first KC-135A Stratotanker rolled out of the Renton factory in less than two years and made its maiden flight on August 31, 1956.

DIFFERENCES — Model 707/717

It is an error to consider the KC-135 (Boeing Model 717) to be simply a military version of the Model 707 commercial jetliner. The Model 707 was developed in a separate program with its first flight occurring some 18 months after that of the KC-135A.

The outward appearance of the Model 707 and the KC-135 bear a strong resemblance — particularly with the shorter Model 707-100/-200 Stratoliners. However, there are major differences between the airplanes. Differences in the fuselage diameters are shown in Figure 1 on page six. While the Dash 80 utilized the same

Thousand Faces

fuselage diameter as the KC-97, studies indicated that an optimum size for both a military tanker and a commercial jetliner would be 144 inches. Subsequent studies revealed that for a commercial airliner the cabin diameter should be 148 inches. This major difference precluded the use of much of the tooling from the KC-135 program. A most noticeable difference between the commercial airliner and the KC-135 is the absence of cabin windows on the later airplane. A boom operator's pod was installed on all variants of the -135.

Fuselage lengths also vary between the airplanes. The body length of the KC-135 is 128′ 10″ while the 707-100/-200 length is 138′ 10″. The 707-300/-400 Intercontinental airplanes have a body length of 145′ 6″. The wing spans on the KC-135 and 707-100/-200 are 130′ 10″. For the Intercontinental jetliners this dimension was increased to 145′ 9″.

Utilization rates between commercial and military airplanes have a relative order of magnitude difference of ten to one. While a KC-135 achieves 375 flight hours per year, a commercial 707 would accrue about 3500 hours in the air. Because of this difference in operation two different design philosophies were employed in the development of the two airplanes. Different materials were selected. To achieve the higher strength-to-weight ratio desired by the Air Force, the -135 structure was designed to a safe-life philosophy; whereas the Model 707 was designed to the fail-safe requirements of the Federal Aviation Administration.

ORIGINALLY DELIVERED -135s

The first KC-135A was delivered to the USAF on April 30, 1957. Less than two years later the Stratotankers were in service with the 93rd Air Refueling Squadron at Castle AFB, California. On January 12, 1965, the last KC-135A was delivered to the 380th Air Refueling Squadron at Plattsburgh AFB, New York. At the end of the production program, 732 KC-135A tankers had been delivered. These airplanes not only form the backbone of America's strategic aerial refueling force, but also service airplanes flown by our Allies' air forces. In the summer of 1975 a number of KC-135As were transferred to USAF Reserve and Air National Guard units, marking the first time the non-regular forces performed a mission for Strategic Air Command. In 1964 an additional 12 tankers (C-135Fs) were delivered to the French Armee de l'Air.

MATS began receiving C-135As in 1961 to serve as long-range logistic transports. These airplanes were powered by Pratt & Whitney J57 turbojets. Next came the TF33 turbofan-powered C-135Bs. The C-135s were operated by the 1611th and 1501st Air Transport Wings, located at McGuire AFB, New Jersey, and Travis AFB, California, respectively.

Turbofan-powered KC-135Bs were produced for the USAF in 1961. These airplanes were redesignated as EC-135Cs and serve as airborne command posts. Under the **Looking Glass** program, one of these type airplanes has been on a continuous airborne alert since February 3, 1961.

Another production version was the RC-135B with turbofan engines. These airplanes were immediately sent to the Martin Aircraft Company, Baltimore, Maryland, for conversion into RC-135Cs with the large side-looking radar (SLAR) cheeks.

The last four airplanes in the family were the RC-135As which were delivered in 1965-1966. These photomapping and geodetic survey airplanes were assigned to the 1370th Photo Mapping Wing, Air Photographic and Charting Service, based at Turner AFB, Georgia.

A summary of the seven delivery configurations of the -135 family are shown on Table 1.

MODIFICATIONS

The basic -135 airframe has lent itself to a large number of uses. A host of reconnaissance derivatives have provided photographic, electronic and weather surveillance capabilities. These airplanes carry the RC/WC designation.

For communications, command and control another series of customized versions were made. Differences result because of specific requirements of the operating command. An EC prefix is assigned to these airplanes. It is interesting to note that the first KC-135A, serial number 55-3118, is still flying as the EC-135K for Tactical Air Command. This airplane's portfolio has numerous letters of commendation from the various distinguished passengers it has carried.

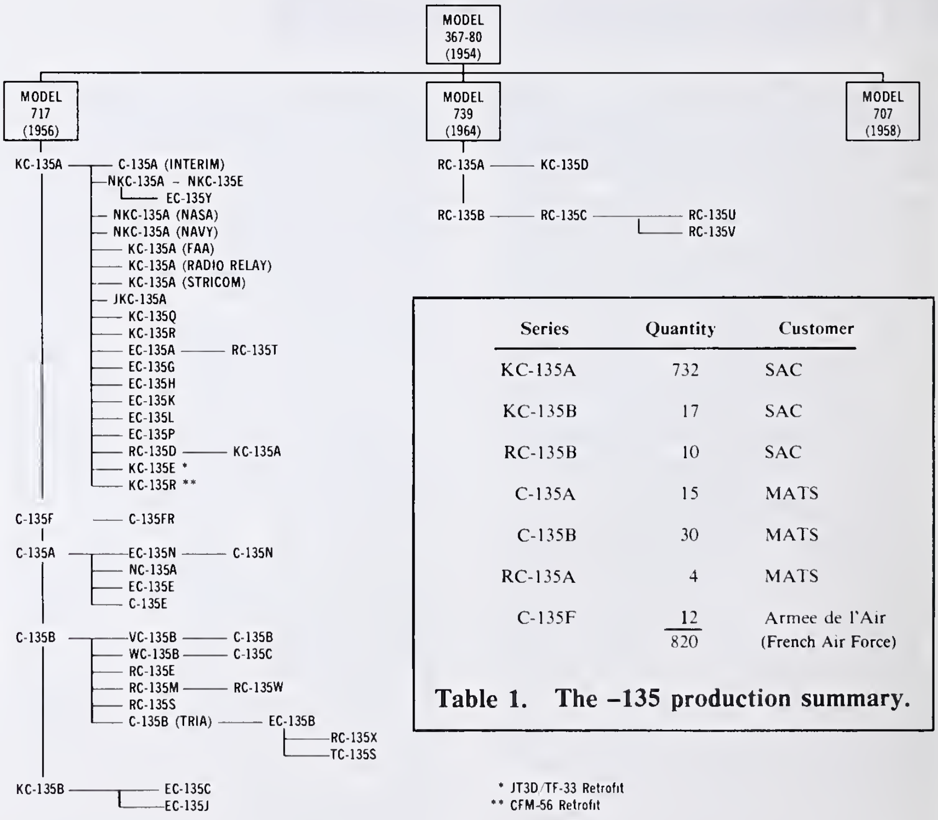
A number of special test airplanes carry the NC/NKC designation. These specially-modified airplanes have changed continuously to meet particular test requirements for the USAF, U.S. Navy, FAA and NASA. They have been used for classified missions, testing new equipment, and chasing eclipses and comets. Many have windows cut into the fuselages resulting in the nickname, piccolo tubes.

FORCE MULTIPLIERS

A pair of re-engining programs for the -135 fleet began in 1982. These programs center around the new General Electric/SNECMA CFM56-2 and salvaged Pratt & Whitney JT3D turbofans. Each of these engines offers significant state-of-the-art improvements over the earlier 1950's-vintage P&W J57 turbojets which are rated at 13,500 pounds of thrust. The CFM56 is in the 22,000-pound static thrust class, while the JT3D is rated at 18,000 pounds. Improved engine performance allows a greater payload/range capability and enhanced engine-out performance. From an economic standpoint, these new engines significantly reduce fuel consumption, thereby resulting in a direct payback; also they make the airplanes better neighbors from the point of view of noise. KC-135As retrofitted with the CFM56 or the JT3D engines are redesignated as KC-135Rs or KC-135Es, respectively.

During the first seven months of 1982, a total of 18 special purpose -135s were retrofitted from the J57 to the TF33 (militarized JT3D). Next in line were the KC-135As assigned to the Air National Guard and the Reserves. The TF33 engines came from retired high-time commercial Model 707 jetliners. Conversion to the KC-135E configuration has resulted in an 18% increase in fuel off-load capability. Parts taken from the retired 707s included the turbofan engines (including struts, cowls and thrust rev-

A KC-97 and its offspring the Dash-80 which led to the first KC-135.



Series	Quantity	Customer
KC-135A	732	SAC
KC-135B	17	SAC
RC-135B	10	SAC
C-135A	15	MATS
C-135B	30	MATS
RC-135A	4	MATS
C-135F	12	Armee de l'Air
	820	(French Air Force)

Table 1. The –135 production summary.

This family tree depicts the originally produced airplanes and their derivations.

An RC-135S prepares to take on fuel.

One of the early Stratotankers delivered to SAC.

ersers), and stabilizers. Use of the series yaw damper permitted operation of the autopilot system in all flight regimes. The horizontal stabilizer was retrofitted to provide the pitch control margins required by the larger engines.

Next came the CFM56 program for Strategic Air Command's fleet of KC-135As and the French Armee de l'Air's C-135Fs. The first KC-135R was delivered to the 384th Air Refueling Wing based at McConnell AFB, Kansas, on July 2, 1984. The first C-135FR was redelivered to the Armee de l'Air in August, 1985. Conversion to the KC-135R model results in a 50% increase in fuel off-load capability.

The KC-135 was the only airplane in the world specifically designed for the aerial tanker mission. During the past 20 years the refueling requirement of the Armed Forces have more than doubled, thereby making the KC-135 an extremely valuable national asset. Approximately 650 of these tankers are in service currently and upgrading them to meet these demands is economically prudent.

SUMMARY

The basic -135 airplane size, range and structure has proven to be extremely adaptable for meeting specific mission requirements, hence the large variety identified on the family tree. Yeoman service is performed on a daily basis by the large fleet of tankers whether they support airplanes transiting their area or provide fuel for mass deployments. It is expected that these airplanes will be in service to the year 2010 or beyond. —Thanks to Boeing **Airliner**/Jul-Sep 1986

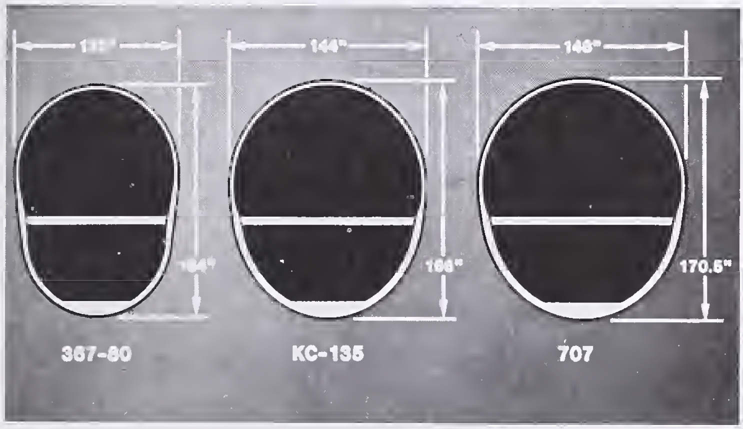
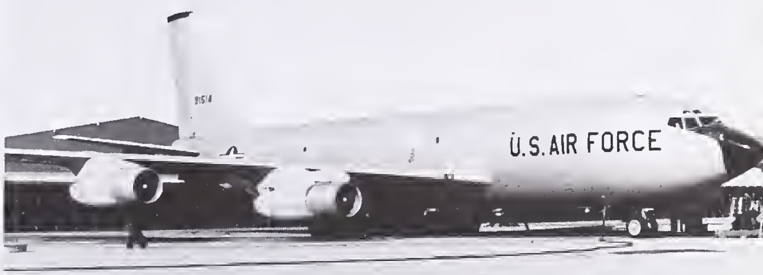


Figure 1. The fuselage diameter differences between the Dash 80, Model 717, and Model 707 are shown in these illustrations.

The first KC-135E was delivered on January 26, 1982.



KC-135 CONTINUED MODERNIZATION

Maj Erv Robinson,
HQ SAC/XPHV

As the Air Force celebrates the 30th anniversary of the first flight of the Boeing KC-135A Stratotanker, plans are in progress to modernize the KC-135 beyond the KC-135E and KC-135R programs; specifically, to modernize the aircraft's cockpit avionic and air refueling systems. Avionic systems will be modernized through the use of solid state digital processors and cathode ray tube displays, and the air refueling system through various current technology hardware changes. These programs will eliminate systems based on thirty-year old technology that require high workloads and high maintenance costs. Modern technology will not only provide a more reliable and maintainable aircraft, but will also provide operational capabilities which will enhance crew performance and mission effectiveness.

The avionics modernization of the KC-135 will center around an integrated flight management system to interface with digital computer systems to provide flight attitude, performance management, flight instrument displays, air data, and caution/advisory functions. These functions will be achieved through the integration of new subsystems like laser gyro inertial reference units, flight management computers, a data transfer system, additional integrated control display units, digital color weather radar, and a multicolor cathode ray tube instrument display system.

Current plans to modernize the KC-135's aerial refueling system include an improved aerial refueling boom, improved boom nozzle, and boom operator station improvements. The improved boom will expand the air refueling envelope with all-receiver aircraft, especially the large receivers (KC-10, C-5, E-4). It will also include redundant boom nozzle lighting and an independent disconnect capability. The nozzle lighting will ensure adequate lighting for night operations and the independent disconnect capability will allow the tanker to retract the boom nozzle from the receiver's receptacle when the receiver system fails to operate normally. The boom station improvement will include enhanced environmental control in the boom pod and add the capability for the instructor boom operator to be able to have instant communication capability with the receiver and the tanker crew.

Additional plans are to modify some of the KC-135s with a wing-mounted hose reel system. The hose reel will allow the KC-135 to be used as a general purpose tanker, that is, being able to refuel boom/receptacle and hose/drogue receivers during the same sortie.

All these improvements will increase the KC-135's viability and effectiveness well into the 21st century.

Material for this article was extracted from the Boeing Company's KC-135 Aerodynamic Flight Characteristics Base Tour Question and Answer Document, KC-135 Aerodynamic Flight Characteristics, C/KC-135 Asymmetric Flight Characteristics, and the CCTS IP Handbook.

-135 Crosswind Landings

Maj Dave Patton 24 SRS, Eielson AFB

"Bozo 50, cleared to land runway 14, winds 230/20 Gusts 25." To many -135 drivers such a clearance may be so familiar that their approach and landing could be accurately described as little more than routine. To others, those words from a tower controller may bring on symptoms ranging from sweaty palms to downright terror. Before my current assignment to RC-135s at Eielson and regular crosswind landings at Shemya, I fit into the latter category. But now that I've experienced a challenging landing or two, I'd like to share some thoughts about landing the -135 in crosswinds.

Remember the phrase your CCTS instructor beat into your head, "Fly the airplane"? Although applicable to all phases of flight, nothing could be more true during a crosswind landing. After all, a good crosswind landing is like any other good landing — it begins with a good approach. Terminate the approach by touching down with the wings level and then hold the wings level with lateral control throughout the landing roll. Keep the aircraft on runway centerline with rudder control. Sounds easy, but before you go charging out to tackle a 25 knot direct cross, let's go back to the approach and fill in the blanks.

On final, the airplane will react to wind gradients and gusts for both the headwind and crosswind components. These further complicate the crosswind problem and unless compensated for, the airplane may land short or too long.

There are two accepted methods used to perform an approach to landing in a crosswind — the "crab" and sideslip methods.

The objective of the "crab" crosswind technique is to maintain wings level throughout the approach, touchdown and landing roll. On final approach, a crab angle is established with wings level to hold the airplane on the desired course until just prior to touchdown. Application of downwind rudder is started just prior to touchdown to eliminate the crab and align the centerline of the airplane with the runway centerline.

As the rudder is applied, the upwind wing will sweep forward, developing roll. Hold the wings level by simultaneously applying lateral control into the wind. The touchdown is made with crossed controls. The lateral control input can be held nearly constant during touchdown and start of landing roll.

A properly performed maneuver will result in the rudder and lateral controls being positioned in the correct position for the start of the crosswind landing roll, but the timing is critical.

The objective of the sideslip crosswind technique is to hold the airplane longitudinal axis aligned with the course and runway centerline during the final phase of the approach and touchdown. The sideslip method utilizes bank to correct for wind drift, which limits the maximum amount of crosswind for this procedure.

The final phase of the landing approach is made on course with the airplane's centerline aligned on or parallel to the runway centerline. Downwind rudder is used to align the longitudinal axis parallel to the desired track as lateral control is applied into the wind to prevent wind drift. Thus, a steady sideslip is established into the wind to hold the desired course until just prior to touchdown. The wings are leveled at touchdown by slightly decreasing the lateral control input and again the timing is critical.

A properly coordinated maneuver will result in nearly fixed rudder and lateral control positions during the final phase of the approach, touchdown and start of landing roll. This is usually a more difficult technique to accomplish on an extended final because of continual changes of wind direction and velocity requiring changes in aileron and rudder inputs.

In the event the crosswind component necessitates a large bank angle (more than five degrees), it may be necessary to combine the "crab" method with the sideslip method to maintain an attitude which will prevent contact of the outboard engine with the ground. Touchdown is made by a slight increase in downwind rudder as lateral control is changed to level the wings.

Touchdown may be made with the upwind main gear touching down first. If so, lower the downwind gear and nose wheels to touch shortly thereafter. Then either hold the wings level or hold the upwind wing down a very small amount.

With either method the control requirements at touchdown and start of landing roll are the same. Use speedbrakes and wheel brakes normally after touchdown. In either case, make all control inputs smoothly to avoid aggravating the airplane's natural tendency to oscillate (Dutch roll).

As soon after touchdown as possible, lower the nose gear to the runway. The pilot not flying the aircraft should assist by holding the yoke full forward and maintaining lateral displacement of the yoke as required to keep the upwind wing from rising. Do not release the lateral input. The pilot will maintain directional control with the rudder; however, differential braking and nosewheel steering may be required. After positive control is assured, move the speed brake handle smoothly to 60 degrees. Remember, raising the speedbrakes abruptly with the control wheel displaced will induce yaw and lateral oscillations on the runway.

If the runway is anything other than dry, check the Maximum Allowable Crosswind During Ground Run chart. This will give you the maximum crosswind in which you can maintain directional control on the runway for a given gross weight and RCR.

On final thought, a crosswind landing is not the time to water your crew's eyes with a "roller." Deliberately holding the airplane off the runway for a smooth touchdown in a crosswind can be hazardous to your health. Fly the airplane to your aim point, flare and put it on the deck. **FLY SAFE!**

KC-135 Pod Proofing

Maj George Jeffcoat
CFIC, Castle AFB

Statistics indicate that not many of you have had the unfortunate experience of dragging an engine pod on the runway; however, I feel confident in paraphrasing an old adage here. There are those who have, and there are those who will experience a close encounter of the dragged pod kind.

I'm sure there are many of you who have rapidly exited the aircraft after landing to check the pods for scrapes, feeling very relieved after finding none, but somewhat baffled as to their absence. Along these same lines, for those who have dragged a pod, many were unaware of the incident until notified by tower or finding the evidence on their postflight inspection. What I'm trying to point out here is that there is an apparent lack of understanding as to what causes a pod to be dragged on the runway. The purpose of this article is to clarify the major causes of dragged pods on the KC-135 and identify available clues that will enable the pilot to recognize a dangerous situation in sufficient time to take proper corrective actions.

What factors contribute to a pod incident? A joint study conducted by SAC and Boeing identified three major factors in virtually all dragged pod incidents: **bank angle, sink rate** and **off runway centerline.** Surprisingly, crosswinds were not a major contributor, in fact, most pods were dragged during four engine fifty flap approaches in light winds. Those incidents that did occur in crosswind conditions usually involved dragging an upwind pod. The cause here was a combination of the above factors in that the aircraft was allowed to drift off centerline during the flare to the downwind side of the runway and the pod was dragged as a result of an overcorrection back to runway centerline. Let's examine each of the three major factors in detail.

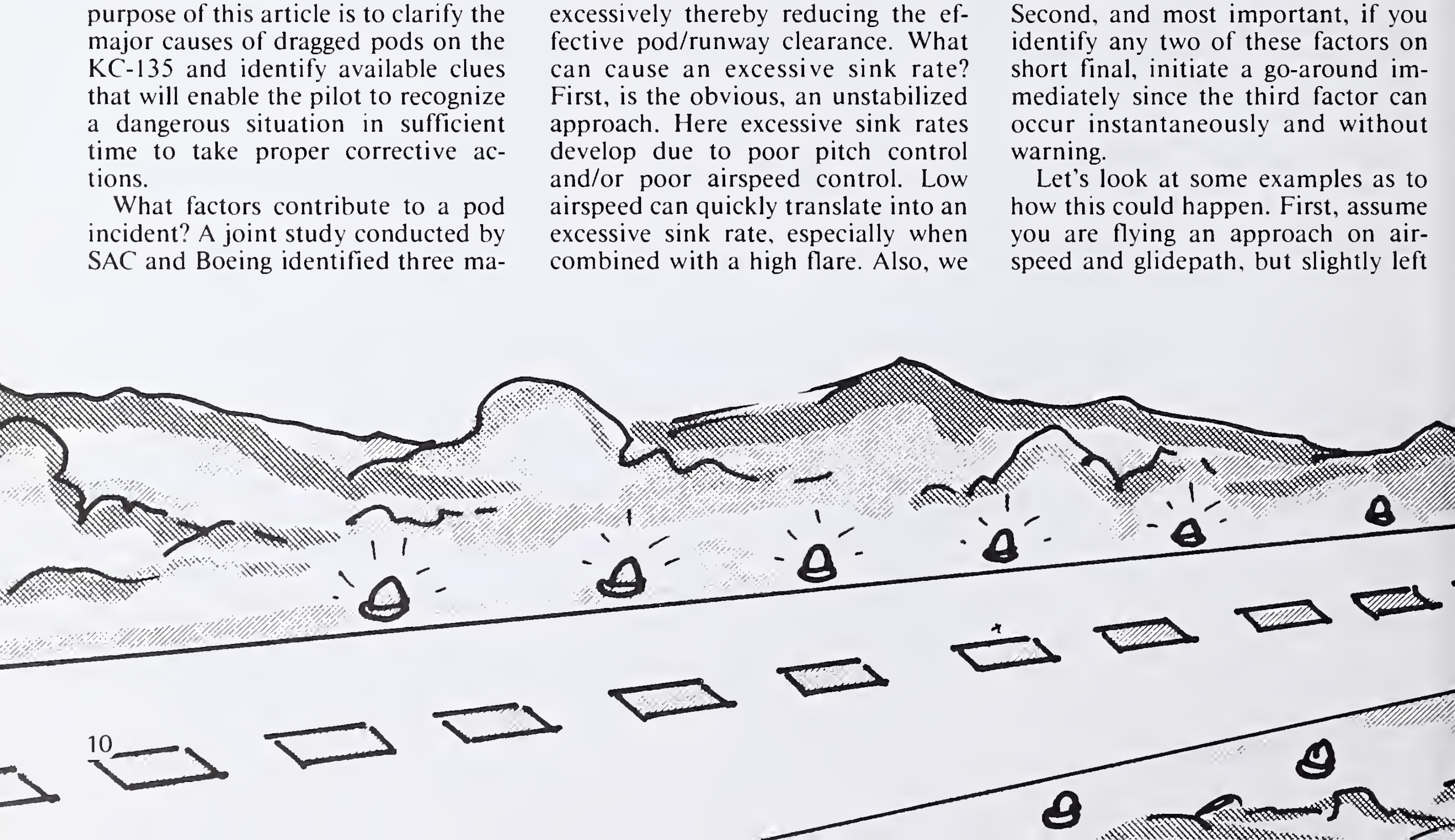
First, bank angle. Our Dash One tells us we have eight degrees of bank angle available before we drag a pod. Is this always true? The answer is no. This angle can be drastically altered by the other two factors as will be shown later.

The second factor is sink rate. The eight degrees bank angle limit mentioned above is based on normal sink rates. A higher than normal sink rate at touchdown will compress the struts excessively thereby reducing the effective pod/runway clearance. What can cause an excessive sink rate? First, is the obvious, an unstabilized approach. Here excessive sink rates develop due to poor pitch control and/or poor airspeed control. Low airspeed can quickly translate into an excessive sink rate, especially when combined with a high flare. Also, we are always faced with the sudden no-notice increase in sink rate due to wind shear.

A third factor is touching down off runway centerline. Landing off runway centerline reduces our margin for error. On a 300 feet wide runway with a 1.5 degree crown, landing off centerline can reduce the eight degrees of bank available to only six degrees. **(See figure 1)** Also, landing off centerline contributes to the introduction of bank angle in an attempt to correct back to centerline. This bank angle could then quickly translate into an increased sink rate due to the loss of lift thus providing the third factor needed to drag a pod. Proper centerline alignment will not only help avoid these pitfalls, but will also provide an increased margin for error. If you are successful in touching down on centerline on the same 300 feet wide runway with the 1.5 degree crown, the available bank angle is increased to 9.5 degrees. **(See figure 2)**

Now that you know the three primary factors, how can you use this information to your advantage? First, always be aware of these three factors. Second, and most important, if you identify any two of these factors on short final, initiate a go-around immediately since the third factor can occur instantaneously and without warning.

Let's look at some examples as to how this could happen. First, assume you are flying an approach on airspeed and glidepath, but slightly left



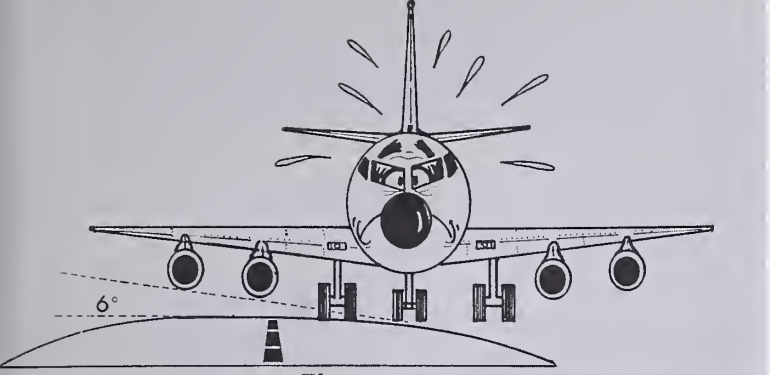


Figure 1.

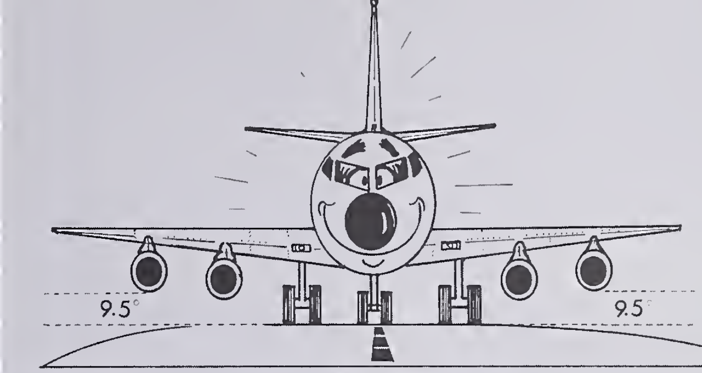


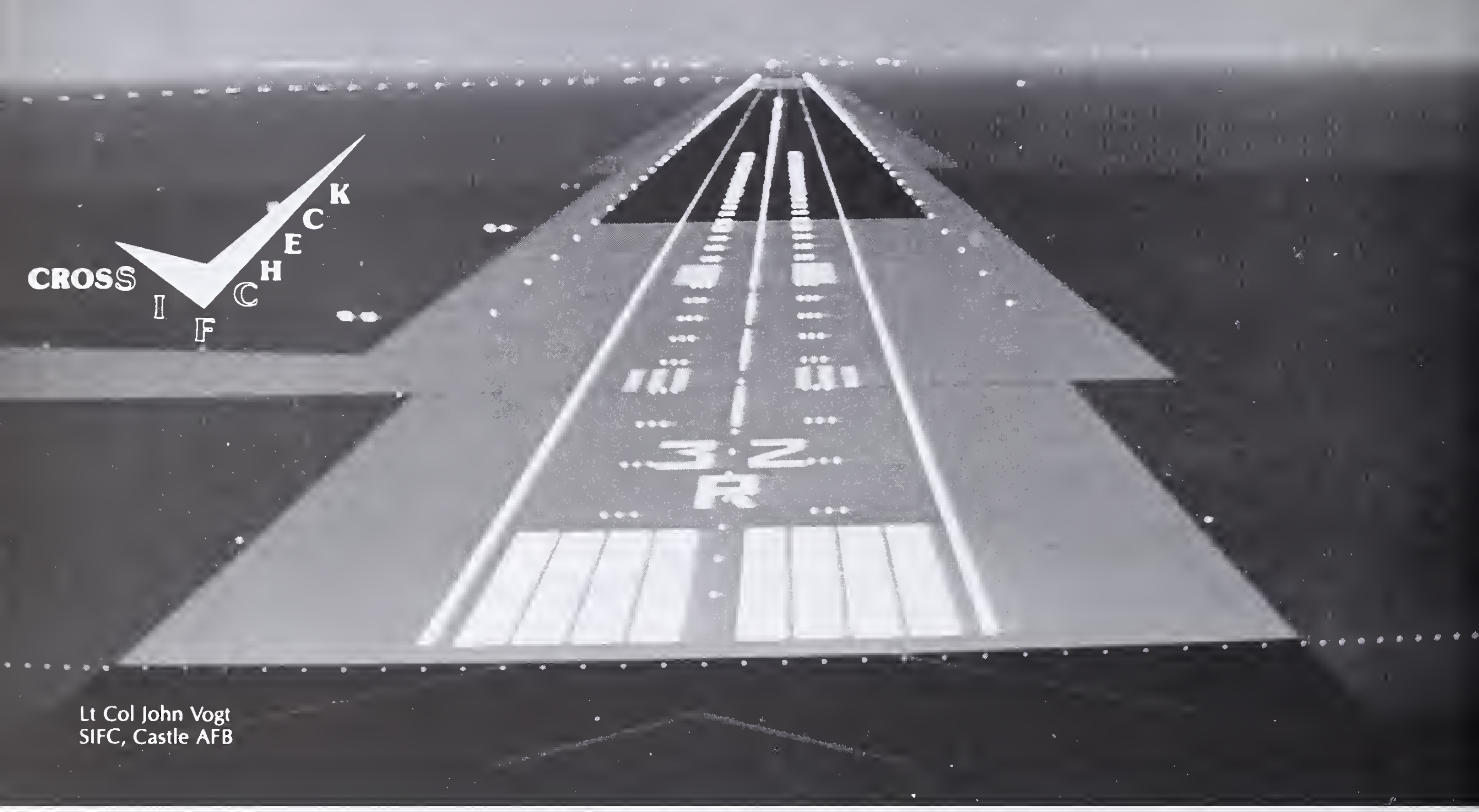
Figure 2.

of course. As you cross the threshold you begin a gentle correction back to centerline. You now have two of the three conditions, off centerline and bank angle. A sudden wind shear or unintentional high flare coupled with idle power could set up an excessive sink rate, the third factor needed to drag a pod. Another example occurs as you cross the overrun and notice a slightly higher than normal descent rate due to low airspeed. You elect to continue even though you are right of centerline. A sudden gust of wind, wake turbulence from a preceding aircraft or any attempt to correct back to centerline could introduce the bank needed to drag a pod. The bottom line is to establish approach parameters as to how much deviation you will accept, keeping these three factors in mind. Once these are established do not exceed them for any reason in flight.

Last, a word to instructors. When you perform a landing attitude demonstration, keep in mind that the purpose of this demonstration is to show the correct landing attitude, not to demonstrate the maneuverability of the aircraft in the flare. We do not want to teach how to salvage a landing from a bad approach or improper flare. The proper corrective action in such a situation would be the timely initiation of a go-around.

"Knowledge of the facts that lie behind incidents and mishaps is the strongest tool to employ in their prevention." Gen Curtis E. LeMay, USAF, (ret)

Look Out for Landing Illusions



Lt Col John Vogt
SIFC, Castle AFB

The weather was 200 overcast, RVR 2400, rainshowers in the vicinity. JONAH 50 was on short final to a strange field. "No sweat," the pilot said, "I've landed in this kind of weather many times before." The pilot broke out at decision height and looked up to go visual. The last thing the pilot said was "I've got it — I see the approach lights." The plane crashed 1000 feet short of the runway in the approach lights.

If the pilot 'saw the lights' he should have been able to safely land the airplane, right? Not always, it seems. A special National Transportation Safety Board study of airline approach and landing accidents concluded that "almost every mishap occurred after the flight crew had either seen the ground, the airport, or the runway environment." Why? A review of data showed that the pilots were unable to correctly determine the flight path or descent angle after going visual — in short, they had suffered from a landing illusion caused by visibility restrictions, such as heavy rain, fog, blowing snow, etc. Once the pilots went visual, what they saw and what they thought they saw were two different things. They had a perception that was different from reality — in these cases, the results were devastating. Of course, not every landing illusion ends up as a grim statistic; more often the results are a high flare or a hard landing. Let's explore the factors that contribute to landing illusions: weather phenomena, runway topography, and night illusions. Then we'll look at some ways the smart pilot can avoid falling into the illusion traps.

Weather phenomena that limit visibility normally give the pilot the illusion of being high. Rain, the most common condition, reduces brightness and clarity; fog can cause the loss of all visual references and reduces the intensity of the approach lights; smoke and haze tend to blur objects, reduce color contrast and make objects appear farther away. Remember, all these phenomena give the pilot the illusion he or she is high, and the natural reaction is to "duck under," especially when the visibility is less than one-half mile. The duck under is a natural pilot reaction and occurs when the pilot lowers the nose to position the aiming section of the windscreen at the leading edge of the visual segment — that is, what the pilot can see (remember the Shemya mishap a few years back — a classic example!) Snow can be responsible for creating different illusions. Blowing snow produces many of the same problems as heavy rain. When the ground is covered with snow, a pilot can lose up to 90% of normal depth perception. Therefore, depending on other factors such as terrain or runway width (that we will discuss later), the illusion of being high or low can easily be produced. In any case, be especially careful when flying approaches to fields during snow storms and/or when the field is completely covered with snow.

"Proficiency and safety are dependent upon each other for the accomplishment of our mission."

—Gen. Curtis E. LeMay, USAF, (ret)

AFM 51-37 says, and rightly so, that instrument approach lights do not provide adequate vertical guidance to the pilot during a low visibility instrument approach. In poor visibility, especially when the runway surface is not visible, there simply are not enough visual cues available to adequately determine vertical position or vertical motion. Studies have shown that when an aircraft is at or near approach minimums in conditions of limited visibility, the sudden appearance of runway lights often gives a pilot the illusion of being high. They have also shown that when approach lights become visible, pilots tend to leave the established glidepath and rely on the poor vertical cues that they can see outside.

Changes in airfield topography (that which differs from our normal home/airfield picture) can cause convincing illusions. We'll briefly look at runway width, length, slope, approach segment terrain, and runway contrast.

1) Runway width — If your home drome has a 300 foot wide runway and you fly into MacDill AFB, beware. The runway there is 500 feet wide. On short final you're going to feel low, so you flatten your approach and flare. In actuality you have flared early and high and probably dropped it in. One way to avoid this illusion is to note and use the painted 150′ wide runway stripes available on standard instrument runways. Conversely, landing on a runway that is narrower than you are used to gives you the illusion of being high. What happens? You probably flare late and prang one on. Telling the pilot the runway is a different size doesn't solve the problem. Pilots, although usually very smart, cannot make a direct mental correction for this; they often believe the illusion.

2) Runway length — A longer than normal runway (that is, longer than you are used to) gives the illusion of being high — so you naturally want to go lower to get back to your "normal" glide path.

3) Runway gradient also has a bearing on landing illusions. Downsloping runways give the pilot the impression he or she is shallow, so the pilot tends to decrease the rate of descent to get higher for the "normal" glide path. A runway upsloping away from the pilot has just the opposite effect.

4) Approach segment terrain — If the approach segment terrain slopes up and away from the runway, the pilot appears to be low, and tends to fly a higher than "normal" glidepath. Downsloping terrain gives the opposite effect.

5) Runway contrast is another factor that can produce an illusion. When the runway blends with the surrounding terrain, i.e., up north after a snow storm, the runway will appear farther away, so the pilot tends to fly above the normal glidepath.

The runway shape, slope, and surrounding terrain can cause critical visual perception problems even on a clear day. You will tend to land long when:

a. The runway is wider than you are used to.

b. The runway slopes down.

c. There is upsloping terrain off the approach end.

Conversely, you will tend to "duck under" if you think you are high, when:

a. The runway is narrower than usual.

b. The runway slopes up.

c. There is downsloping terrain off the approach end.

Now let's review what illusions we see at night. At night the world loses its three-dimensional nature. The only cue to distance is the time it takes to travel to reach a specific point (light). In fact, we have no physiological ability to judge distance beyond 40 feet day or night. At night, we tend to judge distance on the brightness of the light — that is, bright lights have the illusion of being closer. One thing you can do to check this out is to ask tower to turn up the runway lights while you are on a night approach — Voila! The runway will appear closer.

There's another nasty night illusion called the "Black Hole Effect." This occurs when you fly an approach to a well lighted runway over ground where there are no lights. Without vertical guidance, the pilot will fly a dished out arc approach that hits the ground short of the runway. It is impossible to judge height over unlighted terrain using only runway/approach lights as a reference.

Now that we've given you some idea of what to look for, what can a good pilot do to prevent falling into the illusion trap? First, know the conditions that produce flight illusions. When they exist, be aware of the problems they create. Then, understand how you utilize external visual cues to maintain a visual glidepath. You should also remember that it is a natural pilot reaction to aim for the leading edge of the visual segment. The only way to prevent this from happening is to utilize the aircraft instruments until adequate visual cues are available. It is essential that adequate time be spent mission planning to thoroughly review the approaches and airfield facilities and relate those to what you expect to see. Know what the runway width, length and slope are and what illusion they will create. Check the approach terrain. Study the approach lighting system — the type, length and what you should expect to see when you break out. Lastly, take a look at the runway markings. Your aiming point for a precision approach should be the fixed distance marker (captain's bars), 1000 feet down the runway. Remember, if the approach doesn't look right, in spite of all your preparation, don't hesitate to take it around. Knowing that visual cues can be deceiving, the pilot must continue to cross-check instruments, namely the VVI and ADI. Most pilots find it very difficult to continue to cross-check their flight instruments once the transition to visual has been made. AFM 51-37 recommends that a scan for outside references should be incorporated into the cross-check at an early stage of the approach, even though restrictions to visibility may preclude the pilot from seeing any visual cues. Be on the look out for landing illusions — they can ruin your whole day. **Fly smart and fly safe.**

1986 SA Weapon Comp

Lt Col Robert
HQ SAC/LG

For the first time in 11 years, the annual SAC Combat Weapons Loading Competition will have a new host base. Fairchild Air Force Base will be the site of this year's competition, which will be held 18-25 September. All of SAC's 16 current bomb wings as well as the 43SW, Andersen AFB, will be represented, even though only security police elements will be competing from Dyess AFB and Ellsworth AFB, which are involved in transitioning to the B-1B aircraft.

Last year, the 509 BMW was the first FB-111 unit to win the Barrentine Memorial Trophy — the top trophy of the competition. The trophy was named after CMSgt Wilbur R. Barrentine, SAC munitions loader from the mid-fifties until his death in 1970.

The competition is intended to promote a competitive spirit among units; improve loading, aircraft crew chief, and security police skills; and aid in the evaluation of new concepts. *Esprit de corps* of competing units is also enhanced by the high pressure competition in which only SAC enlisted personnel compete.

The 3000 total points are divided among the three distinct competition areas: munitions (1400 points), aircraft crew chief (400 points), and security police (1200 points). In addition to being evaluated during two different loading operations, munitions personnel will be administered a written test, and their equipment will receive a close scrutiny by evaluators. Aircraft crew chiefs will be evaluated in their preload and postload procedures, as well as given a written test.

Munitions loading will be accomplished on three different types of aircraft — FB-111, B-52G and B-52H. Each load team will be tasked to load simulated nuclear weapons on the particular type of aircraft assigned to their respective wings.

Security police personnel will compete in four separate events designed to test their initiative, skill and knowledge in dealing with threats to security of nuclear resources. A confidence course and combat rifle

Combat Loading etition

Carmichael, Jr

course will test the physical skills of the competitors, while a written test will help determine overall job knowledge. A tactics exercise will test the teams' ability to protect nuclear resources from external threats.

The competition will culminate in an awards ceremony 25 September, followed that evening by a banquet that will be held in nearby Spokane. In addition to the Barrentine Memorial Trophy, other major awards that will be presented include the Best Munitions Load Crew Trophy, Best Security Police Unit Trophy and Best Bomber Crew Chief Trophy.

Regardless of the outcome, preparing for the Combat Weapons Loading Competition is a difficult and arduous job that has occupied a significant portion of each competitor's summer. Motivation and spirit are at a fever pitch and will reach their peak at the competition. **Even though only one team will take the Barrentine home, there are no losers in the SAC Combat Weapons Loading Competition, where the best of the best compete.**

RECENT AWARD WINNERS

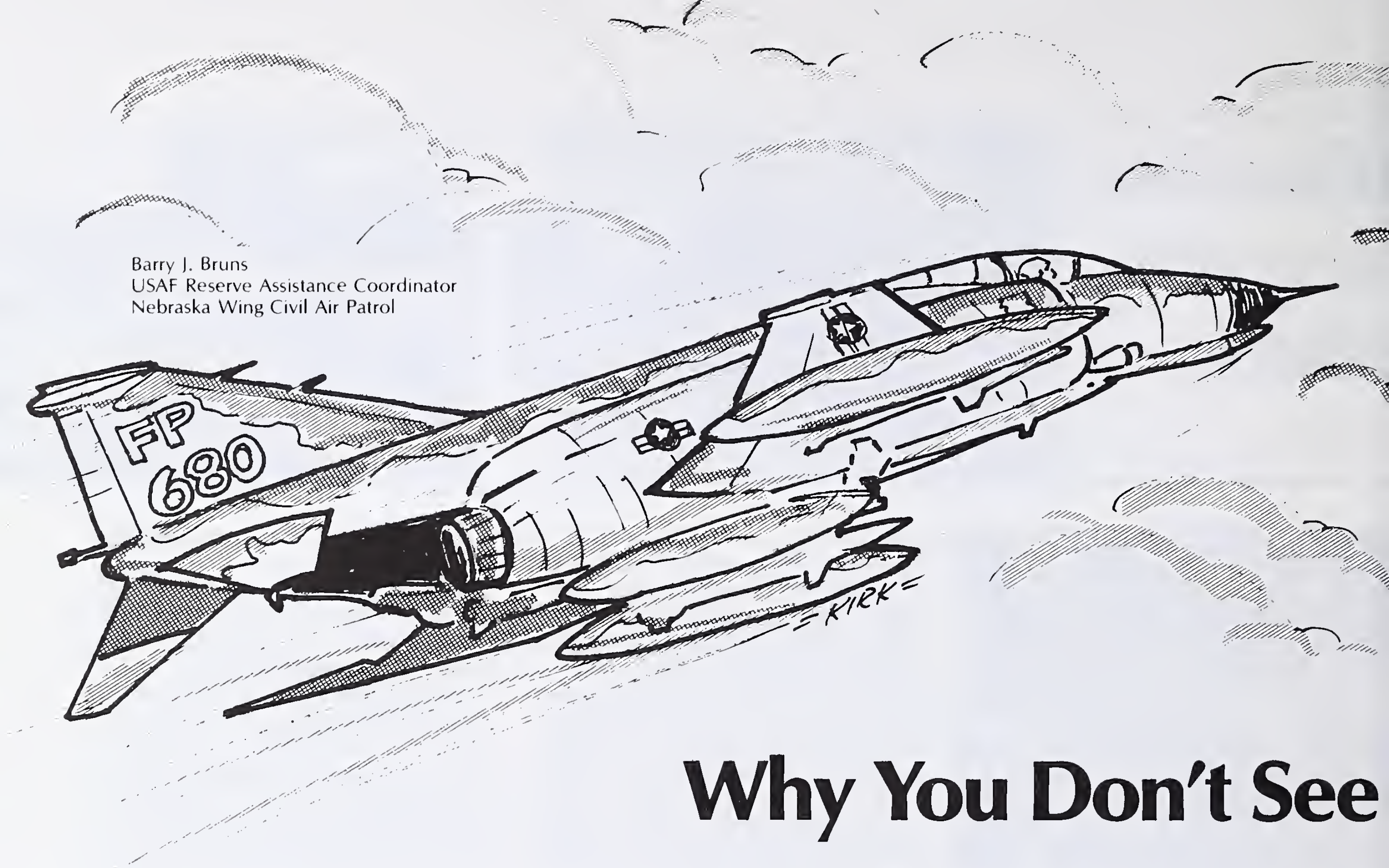
BARRENTINE WINNERS
1985 509 BMW, Pease AFB NH
1984 28 BMW Ellsworth AFB SD
1983 416 BMW Griffiss AFB NY
1982 28 BMW Ellsworth AFB SD
1981 19 BMW Robins AFB GA

BEST MUNITIONS LOAD CREW
1985 509 MMS, Pease AFB NH
1984 93 MMS Castle AFB CA
1983 43 MMS Andersen AFB GU
1982 410 MMS K I Sawyer AFB MI
1981 93 MMS Castle AFB CA

BEST SECURITY POLICE TEAM
1985 96 SPS, Dyess AFB TX
1984 44 SPS Ellsworth AFB SD
1983 320 SPS Mather AFB CA
1982 44 SPS Ellsworth AFB SD
1981 19 SPS Robins AFB GA

BEST AIRCRAFT CREW CHIEF
1985 5 OMS, Minot AFB
1984 28 OMS Ellsworth AFB SD
1983 42 OMS Loring AFB ME
1982 28 OMS Ellsworth AFB SD
1981 380 OMS Plattsburgh AFB NY

Barry J. Bruns
USAF Reserve Assistance Coordinator
Nebraska Wing Civil Air Patrol



Why You Don't See

"MEL, BREAK LEFT NOW!" Before the words were all out of my mouth my wingman's F-4D was in a 90° left bank. Within the next second or two an orange and white single engine Beechcraft occupied the airspace that Mel and his backseater would have been in. My wingman was flying a modified tactical formation at the time of the near hit — line abreast with 1000 feet spacing. He and the Beech were on a reciprocal head-on collision course. Close, real close.

But why did I see the other aircraft before my wingman did? Why did the pilot of the small aircraft not see our formation in time to avoid us? Indeed, as we passed behind him there was no indication that he had seen us at all. Answers to these questions reveal information which explains most VFR mid air collisions. There is a common factor in all mid airs that I have never seen discussed in print.

What do you look for when searching the sky for other aircraft? You probably will answer "movement," or "relative motion." That is what draws most of our eyes to other aircraft. Many instructors teach their students to scan the horizon out of the windscreen, looking for movement. There are several things wrong with this method. First, it tends to keep the eyes looking at a blank sky for too long, resulting in an automatic refocus of about three to six feet in front of the pilot's nose. Second, the scan ignores aircraft above or below the horizon. Third, the method assumes that aircraft not in front of the scanner's airplane are not a big factor, and fourth, pilots trained this way seldom move the plane around or move around within their cockpit. The scan will normally pick up another craft NOT on a collision course because of relative motion. Just as a hunter sees flying birds out of his peripheral vision, the movement of another aircraft relative to the scanning pilot attracts his eye.

But what is the common factor behind mid airs? The answer lies in a discussion of some basic intercept geometry. Military pilots call it that, but submariners, tug boat captains, automobile drivers, even cowboys use it. The geometry which is so useful in bringing two moving objects close together also works against pilots looking for another airplane on a collision course.

Let us begin simply. Approaching an intersection on a country road you see another automobile approaching the intersection on a right angle road. Have you ever wondered how you seem to know if the other car will beat you there, or whether you are safe to pass in front? You probably know right away if it looks like you are going to get there at the same time. But how? You know because if you are on a collision course the other car does not change position on your windshield. ON A COLLISION COURSE, THERE IS NO APPARENT MOTION. Consider the simplest example. Two automobiles approach an intersection at a constant sixty miles per hour, each one mile from the crossing. What is the angle between the path of one and the converging vehicle? Simple, you say,

the One That Kills You

forty-five degrees. Okay, what is the angle thirty seconds later, when they are a half mile from the intersection? Still simple, still forty-five degrees. Are you getting the picture? The angle between the two cars remains constant. What if the two drivers relied on relative motion to clear intersections? How many accidents like this leave the drivers saying "Where did that guy come from?" I never even saw him."

The angle between the automobiles approaching a collision at an intersection does not have to be forty-five degrees, obviously. The angle is determined by connecting the tails of their vectors with the vector points touching at the intersection. Unequal speed only results in different length vectors.

Consider what may happen if the angle between the two cars happens to coincide with the angle from each driver's eyes to some visual obstruction within his car, such as the rearview mirror, door post or patch of unscraped ice on the windshield. It is no wonder that drivers experiencing such wrecks do not see the other guy until his automobile fills the windshield, or becomes larger than the object hiding it.

If there is relative motion, if the angle is changing, the points of the vectors do not touch. If the other car is moving back away from dead ahead you will pass in front of it, and if it is moving toward your front you will pass behind it. Country boys used to use this technique to show their bravery racing trains to uncontrolled grade crossings. The smart ones knew they would win. The others . . . well, it is difficult to miscalculate enough to pass behind a train. However, if the second sort of guy were suddenly to become a quick learner, he would be able to predict which train car he would hit. It would be the one that does not move across the windshield. Again, there is no relative motion in a collision course.

If the other aircraft, or whatever, is maneuvering, the collision angle constantly changes and the interceptor uses its computer or its trained pilot to upgrade the collision course. A good cow pony can do that with little guidance, bringing its rider close to an errant calf in short order.

But we need to be able to apply this geometry lesson toward avoiding the collision course when flying. While setting up a collision course for an intercept is difficult, it seems that all too often fate deals us exactly that. Such was the case in the incident in the opening paragraph. My wingman and the small aircraft were on a collision course of the worst kind — in a head-on situation things happen extremely rapidly, and aircraft are most difficult to see because of the small frontal area. But since we were flying a spread formation I was not on a collision course, and the small amount of relative motion generated helped me see the approaching aircraft just in time. The pilot of the oncoming aircraft evidently was not clearing properly or he should have seen my aircraft, especially considering the huge smoke trail those old F-4's left behind.

Contd. on next page

Why You Don't See the One That Kills You...

Pilots have a more difficult job avoiding collision courses than do drivers of automobiles. Pilots must deal with three-dimensional space, though unless trained in aerobatics most general aviation pilots have difficulty breaking from the one dimensional world of surface travel. Hence the scan-of-the horizon's popularity. Also, speeds of aircraft vary more widely than those of automobiles.

Pilots can take positive action to decrease their chance of a mid air collision, and an understanding of collision course geometry may be the most important basis for successful avoidance. When a controller calls out traffic, or another pilot announces his position, do not simply look in the general direction and hope that your eyes will be attracted to the relative motion of the other aircraft. That will work only if you are NOT on a collision course. First, take a few seconds to imagine the geometry of the situation. Draw those little vector arrows in your mind, and imagine what action you can take to ensure the points do not coincide. A turn toward the rear of the other traffic will normally break the collision course, and if the other airplane is not immediately spotted a small turn away from his projected flight path is in order. This will carry you behind the traffic, and if you were on a collision course you will more easily spot the other aircraft because now it will have relative motion. If you see an aircraft where it is called do not assume that is the only one there. In a mid air between a 727 and a light aircraft over San Diego a few years ago the airline pilots saw a small plane in the general area that traffic was called, but it was not the one which they were on a tragic collision course with. The airplane they hit was hiding behind a portion of the windscreen structure, and without turning their plane or moving around within their cockpit to clear the blind spots they did not have a chance of seeing the dangerous traffic.

The San Diego accident illustrates several conditions that contribute to increased odds for a mid air: traffic unknown to the controllers in a high traffic area, a mix of low and high performance aircraft, and aircraft hidden behind blind spots. The pilot of the smaller plane would have had to look toward the rear out of the side of his cockpit to have seen the airliner. How many pilots regularly look to the rear of their aircraft? If all planes flew the same speed this would not be necessary. But to airline and military pilots even the most high performance propeller driven aircraft in the general aviation category are "bug smashers." It is not necessarily derogatory, but it points out that most fast-mover pilots have had a bad experience with much slower aircraft.

While jet traffic below 10,000 feet MSL is limited to speeds less than 250 knots indicated airspeed, that rule does not apply to military aircraft for which the flight manual dictates otherwise. For instance, the F-4 flies its VFR traffic patterns at 300 KIAS, the venerable old F-104s and F-105s are allowed 325 to 350 KIAS. And on low level training routes military pilots may fly up to .99 Mach, with supersonic low level maneuvering limited to restricted areas. But at 360 knots true airspeed that fighter is moving six nautical miles each minute. At 540 KTAS it is doing nine nautical miles per minute. Under good conditions it is difficult to see a camouflaged fighter at over two miles, and if it is nearly point-on that distance may decrease to less than a mile. If you happen to end up on a collision course with such a fast moving plane, and you are doing a superb job of clearing and see it at two miles, you will have something less than 20 seconds to respond and move out of the way. And remember, there will be no apparent motion to aid you. If you are in the vicinity of high speed traffic and cannot visually pick up a plane you know to be there, do not be afraid to execute 360 to allow the other aircraft to clear the area and to give yourself the opportunity to check all around. If you are under Air Traffic Control and feel you need it, it will not hurt to request a 360. Unless you are in a stream of traffic most controllers will gladly grant you an orbit or two — it might help them out of a difficult situation, and the pilots of airlines and military jets will develop a much needed warm spot in their hearts for you.

Finally, learn and practice better search discipline. Fighter pilots are taught a technique much different than the horizon scan, and it can work for all pilots. Focus on an object or cloud as far from your plane as you can, then move your eyes vertically, searching above and below the horizon, but only for a horizontal area of five to fifteen degrees. Then refocus and repeat. Without forcing yourself to refocus you will shortly not see anything more than several feet away, especially against a clear, blue sky. With practice a pilot can rapidly clear the entire sky, with brief checks within the cockpit between vertical searches to confirm instrument readings. And move your head around, looking behind all those obstacles to your vision, such as door posts, struts, and wings. Bank the aircraft to move the wing out of the way, and if the hair begins to stand up on your neck because you believe you are being overtaken by faster traffic, turn your airplane and have a look. Remember, for purposes of comparison, the yellow arc on the airspeed indicator of a Cessna 172 begins at a speed lower than that necessary to rotate an F-4 on takeoff. You can be overtaken from behind, and knowing you had the right of way will be small consolation to your widow.

Odds are that if you ever have a mid air collision you will never know the other aircraft is near until your **HEAR** it. *Have a happy neck and eye strain on your next flight.*

When You Least Expect It — Expect It!

Lt Thomas G. Dugan
380 AREFS, Plattsburgh AFB

It was to be my first local area flight — the one your nav school instructors say "you'll never forget!" Unfortunately, I will remember this flight for another more important reason.

The day started out like any typical mission. We all met at the squadron — pilot, copilot, instructor navigator, instructor pilot, boom operator, two new copilots and myself. Everything went on schedule until engine start time. A check with the command post revealed that our receiver had just canceled. We went back to the squadron, as requested, and awaited further word. It would be approximately three hours and two mission plans before we would get our final mission change.

As the sun set, we finished another uneventful preflight and were off. As the pilots flew the departure, I did the usual navigator duties — backing up the SID, cross-checking my systems, and making altitude calls. Shortly after takeoff the two extra copilots came up to the cockpit to observe the departure and have the instructor pilot explain any localisms.

A cloud deck was forecast to be to 8000 feet with no associated weather. However, I had configured the radar for weather scan to show the instructor how I would set the radar up to find weather.

At approximately 8000 feet we were above the clouds and I was reconfiguring the radar for ground mapping. Departure control had just cleared us to center frequency. Upon initial contact with center we were advised of traffic in our two o'clock position heading westbound — a C-130. Looking back I remember glancing out the copilot's window, but I wasn't too concerned because of all the **"eyes"** we had in the cockpit. From this point on everything happened very quickly.

I started to enter the time of SID termination on my log for the fix line. It was then that I stopped and looked directly out the pilot's windows. I saw two lights: green in the pilot's window and red in the copilot's window. As I started to key the mike the instructor pilot jumped up and yelled to the pilot. To this day I vividly remember seeing the white and silver light civilian aircraft in a rapidly descending right turn.

The instructor pilot called center and advised them of our near miss while the instructor navigator held the INS for our position. I recorded the time, altitude, heading and position for the report. The moments following the incident could only be summed up in one word: "professional." Although shaken, the crew kept its priorities and held any distracting chatter until later, on the ground.

The remainder of the mission went uneventfully and after landing we filed the required reports and discussed the situation. While many lessons can be learned from our incident, I believe two, less obvious, factors contributed to our near tragedy. First, our delayed takeoff and replanning had caused the crew to become restless and brought fatigue into the picture. Secondly, the additional crew members made the cockpit crowded and allowed confusion to become a player.

While neither of the two factors directly caused our situation, they no doubt contributed to it. As crew members we cannot eliminate delays. But we can recognize that even a minor delay may cause us to became fatigued requiring us to be more attentive to our work. With limited flying time becoming a way of life the number of crew members on each flight can only increase. The **"sardine"** effect can be reduced by discussing, during mission planning, how many extra crew members will be permitted in the cockpit throughout the flight.

Additionally, getting a tally on traffic is important. But ensure that other areas are not neglected too long during the search. This is especially important during climbouts and descents into high density traffic areas. Never assume because there are sixteen sets of eyes in the cockpit that every area is being scanned for traffic.

Finally, as the old saying goes "when you least expect it — expect it." Even though controllers call 99.9% of traffic to us, the other .1% can still kill you if you don't see it in time! As it turned out we were lucky. The other pilot saw us first and took the evasive action to avoid a mid air. His actions saved all our lives. I should know because **"there I was . . ."**

About the author. Lt Dugan, a KC-135 navigator, was stationed at Mather AFB at the time of this incident. He subsequently has been reassigned to Plattsburgh AFB.

Cdr James B. Waddell, USN

Advice to a Fledgling Aviator

Although some specifics of this article from the Navy's Approach magazine may not apply to the SAC crew member, Cdr Waddell's advice applies to all aviators. Ed

A student naval aviator recently asked me if I could offer any advice on the subject of flying. Having survived 15 years of cockpit duties, I figured I would be able to come up with a few personal rules to live by that might extend someone else's career of slipping the surly bonds of earth. For that student pilot, and any other interested parties, I submit the following items for consideration. The list is neither complete nor original, but it works.

Fly defensively. If you make any assumptions, assume everyone is out to get you. Paranoid though it may sound, it only has to be true once. Ground controllers, your flight lead, your wingman or any other pilot in your airspace can cut short your career or at least ruin your whole day. Defensive flying, like defensive driving, is a state of mind more than anything else. It doesn't mean flying scared or unaggressively. It does mean adhering to all those cliches you have heard (or will hear) a thousand times: keep your head on a swivel (because someone is trying to find you and hit you); look both ways before crossing a runway or taxiway, even though you have been cleared (because the controller is trying to find two of you to hit each other); look at your wingman before turning in his direction. I know it's the wingman's responsibility to avoid the leader, but what if the wingman is wrong? It won't make you feel any better.

Never do anything in an airplane today that you wouldn't do any other day.

You may be tempted to make "one-time exceptions" for special events, that chance to solo on a cool CAVU (clear and visibility unlimited) day, that last chance for a cross-country flight back home, your fly-off after a six-month deployment, that chance to press just a little more to get a good bomb hit or gun kill. If it's not combat and you wouldn't take the airplane or perform the maneuver any other day, don't do it today.

Always pass and acknowledge a lead change positively. Your flight instructors will insist, but you might be surprised how many fleet types are lax with this basic rule. Whether by hand signals or radio, let there be no doubt who has the lead, ever. Use your call sign on the radio. If you hear only a "you've got it," steer clear. You will be amazed how many other formation flights are airborne on your frequency.

Use your radar altimeter. Ask any aviator if his radar altimeter has ever gone off when he didn't expect it. How many of those pilots are still here after that surprise we will never know. If it saves you, that's the only statistic that counts. Using the radar altimeter does not mean simply turning it on. Develop a philosophy and live by it. One tactic is to "chase" your altitude, both in climbs and descents, by frequently resetting the bug to just below your target altitude. Sadly, you will probably lose at least one friend who will fly into the water, most likely at night with no sign of a problem. Accident boards seldom recover the evidence to ascertain the victim's radar altimeter philosophy; they can only guess. Remember that a radar altimeter set too low only serves as a warning of imminent death. Do not rely on the radar altimeter to save you. Do use it wisely.

Use checklists. Another basic rule, but all too frequently ignored or forgotten. Don't just read checklists, do them and not by memory. One method is to actually touch each switch or handle on the checklist rather than rely solely on visual cues. Be especially cautious of interruptions to your habit patterns. Many unintentional gear-up landings, for instance, occurred after the pilot interrupted his landing checklist.

Carry and use charts. Everyone carries IFR charts, but what about VFR charts (ONC, TPC, etc)? Some squadrons SOPs require that pilots carry an ONC or TPC with annotated divert fields, hazards and prominent geographical features. This is particularly important when flying in an unfamiliar area. Know the local geography of your arrival airport. When your TACAN and radio fail, the old chart and eyeball will still get you there.

Use the land/taxi light. If you're not doing FCLP (Field Carrier Landing Practice) or blinding somebody who is, why not use the land/taxi light? It seems to be a Navy hangup directly related to the macho image. But there is nothing macho about a midair collision in the landing pattern, taxiing off the runway into the dirt, FODding an engine or colliding with a deer — or worse, another aircraft. All of these have happened and could have been avoided by using the land/taxi light.

Know your limitations. Navy pilots, by definition, have big egos. Controlling the ego is what keeps you alive. Do a thorough self-evaluation before every flight. Are you physically and emotionally prepared to fly the mission to the best of your ability? If not, don't fly. Sounds simple, but the pressures may seem overwhelming on occasion. You may be prepared to fly, but not every type of mission. Just because you have a current instrument card doesn't mean you are proficient to fly in conditions of 200 foot overcast and one-half mile visibility. Know the difference. Maybe you need to fly a different mission, have a simulator or just take the day off. Your operations officer will help, but as always, the ultimate responsibility lies with the pilot. Make the right choice and come back to fly again.

Think "what if?" At the risk of sounding overly pessimistic, you can stay mentally alert by constantly reminding yourself of what you would do if things went wrong. The "what ifs" should begin in the brief by discussing such items as inadvertent IFR, unintentional loss of sight in a formation flight, departure and spin recovery procedures, the emergency of the day and any particulars pertinent to the specific mission. On the runway or catapult, what if you have to abort or eject? Once airborne, what if oil pressure fails, the engine quits or your navigation systems die? Review your time-critical emergency procedures. On approach, have your TACAN approach plate out, even for an enroute descent. What if you lose your radios? What if you don't break out at minimums? What if the aircraft in front of you fouls the runway? "What ifs" are limited only by your imagination. Put another way, it's simply staying ahead of the aircraft. He who is ready lives longer.

Wear your seat belt. What does that have to do with flying? Everything if some bozo rams you with his supercharged roadster on your way home tonight. The other nine rules are meaningless if you buy it on the highway. You are a national asset. Please treat yourself accordingly and happy flying! — Thanks to *Approach,* May 1986

WANTED:

Survival Stories

Do you have a survival story you would like to share? We're looking for people who have experienced a survival episode, either military or civilian, which can be used to enhance our training. We'll use your valuable experience to let others know what might be expected and how they might feel. Please contact us at **3636 CCTW/DOV, Fairchild AFB WA 99011-6024, AV 352-2371/2171** or commercial extension **(509) 247-2371/2171.**

THE CUTTING EDGE

Checklist Discipline — The Basic Skill

Capt James M. Jenkins
3901 SMES, Vandenberg

Checklist discipline is a basic skill essential for success in missile operations. It's so basic many people ignore it while they develop the other skills which comprise the repertoire of a missileer. It's a valuable skill, often mentioned by instructors and evaluators, but seldom defined or developed. This article will hopefully fill some of that gap by defining checklist discipline, highlighting the elements that comprise it, and providing a practical guide to the crew commander who wants to improve the checklist discipline of his/her crew.

Webster's New World Dictionary lists five definitions of the noun **"discipline."** One of those definitions is "orderly conduct." This is the definition that best fits with the use of the phrase checklist discipline as it reflects the orderly processing of checklists. By accomplishing a checklist in an orderly manner, the crew's ability to do its job efficiently and effectively is enhanced. The missile operations manuals were designed to be the corporate memory available to the crew member. These checklists provide directions on how to properly accomplish a task and incorporate such diverse inputs as two-man concept, security, Emergency War Orders, weapons system safety rules, and various other safety considerations. Checklists constantly evolve as crew members refine procedures, the weapon systems change, or new policies are implemented by the command. By processing a checklist in an orderly manner, the crew gives itself full access to this valuable information, thereby providing the difference between mediocrity and excellence. Because checklist discipline can have a tremendous impact on the effectiveness of the crew, it's an area of crew performance each missile combat crew commander should analyze. In that analysis, the crew commander should take into account the two elements of checklist discipline: checklist processing techniques and crew pace.

There is no one checklist processing technique perfect for every crew, though any good technique should include four aspects:

1) Active participation by both crew members;
2) Step-by-step checklist processing;
3) Some method of addressing each warning, caution, note, etc.; and
4) The responsibilities of each crew member during checklist processing.

Normally, both crew members should be involved in a checklist. By having both involved, the chance for a mistake is decreased since each crew member is in the position to correct the mistake of the other. This can be accomplished by both crew members having the operations manual open to the procedure and, as one reads the steps, the other replies with some positive response, i.e., "Okay," "I agree," etc., acknowledging a step has been accomplished correctly.

Step-by-step processing can be one of the most difficult areas to control. As a crew member gains experience, he/she can often anticipate the requirements of a checklist long before the checklist addresses the requirements. This can make checklist processing easier because the individual can use this anticipation to consider what might have to be done, the effect of those actions, the indications expected, etc. However, if not handled correctly, it can be a liability because the crew member is tempted to "jump around" within the procedure or between checklists with no orderly approach to transitions. If this happens, the risk of missing something which affects the situation at hand is increased. A classic example is the crew that initiates a test to a launch facility and receives abnormal indications which constitute a security situation. The crew anticipates the security requirement and declares the security situation before arriving at the step of the checklist directing security. The crew gets involved with the security requirements and forgets to return to the original procedure. As a result, the abnormal indications are never reported to job control. This outcome could be avoided by consistent, step-by-step processing that provides for tracking which checklist steps have been accomplished and which steps are open.

Another requirement for a good processing technique is some method of addressing warnings, cautions, notes, lead-ins, and amplications included in a procedure. These items normally highlight decision points of varying degrees of criticality within a checklist. It's important to the outcome of the procedure that all of these decision points are addressed and correctly applied. The method can range from reading each one out loud, word-for-word, to simply stating, "Note the warning." The key is to address each and spend as much time reading it as needed, i.e., until the crew understands the content.

"Proficiency and safety go hand in hand. Each is dependent upon the other in accomplishing our mission." Gen Curtis E. LeMay, USAF (ret)

The last element of any successful checklist processing technique is individual responsibility. The crew commander should establish who will do what when processing a checklist, e.g., "I'll read all checklist steps during LCC Emergency Shutdown, and you take all the actions while I monitor." There are any number of combinations of reader/doer, each of which has advantages and disadvantages. Which method is selected is not important, but by selecting a method and consistently using that method a crew can avoid confusion during critical phases of procedures.

Checklist processing technique is only one aspect of checklist discipline. Equally important is the speed at which checklists are processed. Each crew has a pace at which it can most effectively work. That speed is dependent on experience level, proficiency, comfort range, and the situation. It's the responsibility of the crew commander to evaluate these factors and set a pace for the crew that aids it in getting the job done accurately, and meeting associated time constraints. The goal is to do the job right, not set a new speed record for accomplishing the procedure. Too often a crew will try to exceed its capabilities just to process a checklist quickly. Once a crew begins to exceed its maximum effective pace, checklist discipline begins to deteriorate. Often, this causes the crew to make avoidable mistakes. Therefore, an important part of a crew commander's job in developing checklist discipline is to set and control an effective crew pace.

Experience level must be considered. If all other variables are equal, the greater the experience level, the faster the crew can process a checklist. For the individual, experience can bring a broader knowledge of the weapon system through exposure to classes, informal discussions, scenarios, and variations on those scenarios. This information can be called on to reduce decision-making time when reacting to a given situation. Experience level for each crew is slightly different. Here, we are looking at the time spent as an integral crew. As the crew members work together, they develop an understanding of their strengths and weaknesses, and crew procedures are developed either consciously or subconsciously. This results in reduced crew reaction time. Collectively this allows the crew to set a faster pace.

A more proficient crew member is better able to analyze situations, research requirements and accomplish the physical requirements of a task. If all other things are equal, the more proficient crew member will be able to accomplish a task faster than someone less proficient. This, in turn, will enable a crew with a higher proficiency level to run a checklist faster than a less proficient one.

When processing a checklist each person has a speed at which he/she feels most comfortable. Two equally proficient and experienced crew members given the same situation will choose to accomplish a procedure at different rates. This may be the result of reading speed, self-confidence, emotional state, etc. But if an individual deviates too far from that speed (fast or slow), he/she begins to feel uncomfortable. A crew commander should be aware of that and try to find a pace which is within the comfort range of both crew members, yet which still meets the requirement of the situation.

The last factor that can have an effect on crew pace is the situation, and in a way, it is outside the control of the crew. There are times in missile operations that, because of weapon system requirements, Emergency War Order requirements, or the volume of status to be handled, speed is a requirement. The crew commander must adjust crew pace to meet the situation, and conversely, when the situation has passed, slow the crew pace to an appropriate range.

Checklist discipline is a skill that must be developed, practiced and refined. It is not a natural gift. Establishing crew procedures for checklist processing and setting a pace for the crew are responsibilities of the crew commander. When a crew commander is establishing a program to improve the checklist discipline of his/her crew, there are two areas at which to look: checklist processing technique and crew pacing. The commander should establish a technique that provides for:

1) Active participation;
2) Step-by-step processing;
3) Some method of addressing warnings, etc.; and
4) Outlining the responsibilities of each crew member during checklist processing.

When setting a pace, the commander should ensure his/her crew does not exceed its effective speed. Some of the factors he/she should consider are:

1) Experience level;
2) Proficiency level;
3) Comfort range; and
4) The situation.

Checklist discipline is a basic skill that can enhance the performance of the crew, especially when addressing an emergency situation. It is well worth the time spent in developing it.

PROFESSIONAL PERFORMERS

Flying Crew

Crew R-20, 528 BMS, departed Plattsburgh AFB on a normal training flight. The aircraft commander, Capt Donald T. Watkins, leveled his FB-111A at FL 260 when the radar navigator, 1Lt Steven G. Moore noticed the left oil pressure gauge jumping erratically from 0-30 PSI (40-50 PSI is normal). With all other engine instruments normal the crew suspected a bad gauge transmitter and reduced the power setting on the left engine hoping the pressure would return to normal. With the pressure continuing to fluctuate, Capt Watkins coordinated with ARTCC for clearance back to Plattsburgh AFB while Lt Moore determined a heading to the emergency fuel jump area and reviewed the dash-one procedures for a single engine landing. The crew initiated emergency fuel dump procedures to adjust the aircraft gross weight from 89,000 to 66,000 pounds. When Lt Moore moved the fuel dump switch to OFF to complete the fuel dumping procedures, the fuel kept dumping. Capt Watkins immediately made a hard bank back to the runway and rolled out 55 miles south of the base with 7,000 pounds of fuel remaining, while Lt Moore turned off all fuel switches, pulled all the fuel circuit breakers and accomplished critical checklists. These actions reduced the fuel dump rate to something less than the normal 2,300 pounds per minute. A quick estimation by Capt Watkins indicated the crew was about nine to ten minutes from landing with an equal amount of fuel on board. The crew considered landing on the nearer nonoptimum runway but Lt Moore determined the landing data with the existing winds would not allow it. The crew flew an uneventful single engine approach and landing. Capt Watkins and Lt Moore then emergency egressed the aircraft because fuel was still dumping and pooling under the aircraft. Post flight indicated less than five minutes of fuel remaining. Maintenance investigation revealed a failed dump relay which probably occurred during the fuel dumping procedures. This failure made it impossible for the crew to close the dump valves from the cockpit. The decisive actions, intimate systems knowledge and superb crew coordination of Capt Watkins and 1Lt Moore resulted in the safe recovery of a valuable national resource.

Munitions Maintenance

TSgt Keith L. Forbes, 42 BMW, Loring AFB, is SAC's Munitions Airman of the Month.

Currently assigned as the NCOIC of the equipment maintenance branch, TSgt Forbes manages all powered trailer and support equipment maintenance activities. Since his assignment as NCOIC, TSgt Forbes has worked relentlessly at upgrading an unsatisfactory branch to an excellent one. He analyzed and evaluated branch maintenance procedures and operations, totally involving his subordinate supervisors in identifying improvement areas. He then devised new inspection and training procedures to increase the quality of equipment maintenance. The results were immediate and long lasting. Equipment inspection ratings improved from marginal to excellent as noted by the last MSET visit. All rated areas in the branch increased at least two increments higher than the previous MSET evaluation as TSgt Forbes received the MSET Technical Excellence Award for his contributions to the outstanding performance of the squadron's AGE Servicing Section.

Missile Crew

The 308 SMW Crew E-162, consisting of 1Lt Gary S. Lukach, MCCC; 2Lt Dwayne R. Turmelle, DMCCC; TSgt Alan L. Oelschlager, MSAT; and SrA Phillip Sells, MFT, is SAC's Missile Crew of the Month.

Crew E-162 exhibited superior performance under potentially dangerous conditions during strategic alert duty. After a Propellant Transfer System (PTS) team had completed an oxidizer pump connection, Crew E-162 received indications of oxidizer vapor in the launch duct. They immediately implemented their hazard checklist and notified appropriate agencies. Safety of the maintenance teams was their primary concern. While Lt Lukach directed the time critical actions of the crew, Lt Turmelle was charged with evacuating the 14-member PTS team to a safe location and passing vital weather information and propellant tank pressure readings to wing command post. TSgt Oelschlager assisted the DMCC by obtaining missile tank pressures while SrA Sells set up Propellant Vapor Detectors (PVDs). The PTS team was dispatched to the silo where they discovered a defective bolt on the oxidizer pump. During another alert, Crew E-162 was processing their security alarm checklist when a team reported their PVD was indicating presence of oxidizer vapors. The crew quickly recognized the problem as a malfunctioning PVD and then terminated the hazard checklist. Crew E-162's prompt, decisive action and professional knowledge eliminated potentially serious incidents.

Aircraft Maintenance

SSgt William R. Weaver, 42 BMW, Loring AFB, is SAC's Maintenance Airman of the Month. SSgt Weaver recently saw a need for an adapter for the coupling splines on constant speed drive assemblies. His design was accepted by the Air Force Suggestion Program as the adapter saves 70% man-hours and 80% resources on constant speed drive assembly maintenance. During a recent MSET visit, SSgt Weaver's motivation and expertise as the quality assurance evaluator for the propulsion branch contributed to an "outstanding" rating for the branch and an "excellent" rating for the squadron. This was the highest point rating MSET had awarded any propulsion branch in over eight years. His training techniques for tasks and supervisor evaluations were outstanding and received complimentary comments during the outbrief. When a B-52G aircraft ran off the end of the runway, SSgt Weaver was selected as the technical expert in charge of the aircraft engine and associated equipment actions needed to prepare the aircraft for removal. Working in subzero temperatures for five consecutive days, SSgt Weaver was instrumental in the safe and expedient removal of the aircraft.

Missile Maintenance

Sgt Russell D. Ashcraft, 321 SMW, Grand Forks AFB, is SAC's ICBM Maintenance Airman of the Month. Assigned to the electro-mechanical team section (EMT), Sgt Ashcraft recently helped accomplish a forced entry into a launch facility to avoid canceling a missile emplacement. Using his knowledge of the site security system, he helped reduce the average number of camper alert teams on site from 6 to 2.6 in 7 months. During the last SMES visit, Sgt Ashcraft performed indepth predispatch briefings for teams being evaluated. His dedicated effort to pass on his comprehensive weapon system experience contributed immensely to the 96.2% proficiency rating achieved by the section. He maintains a flawless quality assurance evaluation and inspection record. His 100% pass rate and his inspection reports reflect accurate "by the book" maintenance on every task. He maintained a 97.5% average score on monthly code handler's tests during the last six months and has scored a perfect 100% on all "Short Sprint" and higher headquarters code handlers tests during the last eight months.

SAC SAFETY SCREEN

325 BMS, Fairchild Crew R-43: P Capt Loren G Pryor, CP 1Lt David T Zehr, RN Capt Vernon K Alls, N 2Lt Victor F Wade, EWO 2Lt Dayle F Dabney, AG SSgt Lawrence R Delgado

351 SMW, Whiteman Crew E-151/E-150: MCCC Capt William L McIntyre, DMCCC 2Lt Steven P Garippa

308 SMW, Little Rock Crew R-124: MCCC Capt Heinz-Peter L Bergann, DMCCC 1Lt Stephen W Mentel, MSAT Sgt Robert L Davidson, MFT Sgt Mark H Ridings

321 SMW, Grand Forks Crew R-141: MCCC Capt Keith A Miller, DMCCC 1Lt Steven C. Gotschall

44 SMW, Ellsworth Crew E-113: MCCC 1Lt Kevin R Wilkerson, DMCCC 2Lt Donnie G Chappell

4 ACCS, Ellsworth Crew E-105P: P Maj Pat McKinney, CP 1Lt Don Williams, N 1Lt Milt Jordan, BO SSgt Ricky Geiger, Ops Ctlr Maj Terrance Danford, EA NCO Sgt Robert Morris, Force Status Ctlr TSgt George Mitchell, Intel Planner Capt Harold Broth, Intel Planner Capt Don Wellman, Ops Planner Maj Robert Marsh, Ops Planner Capt James McGrail, Logistics Planner Capt Mike Lyons, Logistics Planner CMSgt Jim Frie, CCO Capt Gene Archambault, RO-1 SSgt Jerry Casavan, RO-2 Sgt Marco Chiraini, Data Opr SSgt Marion Martin, 616-A Opr SSgt Clarence Lewis, AFSAT SSgt Loren Anderson

28 AREFS, Ellsworth Crew E-105: P Capt Richard Antaya, CP 1Lt Raymond Lamarche, N 2Lt Scott Barner, BO A1C Edward Paver Jr

97 AREFS, Blytheville Crew R-106: AC Capt Randall E Burnett, CP 1Lt Scott F Stonier, N 1Lt Marcia M Walker, BO TSgt Eric E J Riker

97 AREFS, Blytheville Crew R-123: AC Capt Robert Whittenberg, CP Capt Glenn H Tarsi, N Capt Ector D Shepard, BO Amn Brett A Howard

340 BMS, Blytheville Crew S-22: AC Capt Marcus R Drinkwater, CP 1Lt Earl B Glazer, RN Capt Rodger A Soard, NN 1Lt John W Chittum, EW 1Lt David G Stewart, AG Sgt Randal L Smith

340 BMS, Blytheville Crew E-40: AC Capt Charles A Saxon, CP Capt William M Reed, RN Maj Lee W Stone, NN 1Lt William H Taylor, EW 1Lt Luke A Shingledecker, AG TSgt Joseph W Corbin

68 AREFG, Seymour Johnson Crew E-010: AC Capt Lee J Douet, CP Capt Ernest Felts, FE MSgt Eugene Forman, BO MSgt Patrick Kennedy

906 AREFS, Minot Crew S-103: IP Capt Christopher N Milodragovich, CP Capt Susan H Seamens, IN Capt Joseph T Miller, IBO Sgt James C Youngblood

906 AREFS, Minot Crew R-112: P Capt Thomas Dean, CP Capt Eric Nelson, N 2Lt William Sargent, BO SrA Thomas Axthelm

23 BMS, Minot Crew E-23: P Capt Greg Zimmerman, CP 1Lt Gary Stanislawski, RN Capt Mark Hawks, N 1Lt Ken Hlavacek, EWO Capt David Bucknall, G TSgt John Marsden

23 BMS, Minot Crew E-34: P Capt Robert Bruley, CP 1Lt Eric Rios, RN Capt James Murfee, N 1Lt Steve West, EWO 1Lt Edward Jaeger, G SSgt Christopher Austin

23 BMS, Minot Crew E-44: P Capt Rusty McDaniels, CP 1Lt Eric Taylor, RN Capt Richard Werling, N 1Lt Michael Harvey, EWO 1Lt Thomas Spinelli, G SSgt James Lockhart

46 BMS, Grand Forks Crew E-23: P Maj Edwin B Frazier Jr, CP 1Lt David E Kugler, RN Capt Dennis J Murphy II, N 2Lt James M Dukes, EWO 1Lt John T Dorsey, G SSgt Robert V Miles

905 AREFS, Grand Forks Crew E-111: P Capt Mick D Young, CP 1Lt David D Brook, N Maj Richard P Graziano, BO A1C David K Curtis

The SAC Safety Screen is an honor roll of SAC's most professional crews. To gain listing on the Screen, crew members must be nominated by their unit commanders and meet high selection criteria of experience in their aircraft or missile system *IAW AFR 127-2/SS1.*

905 AREFS, Grand Forks Crew E-115: P Capt Tracey E McFadden, CP 1Lt Michael D Lorimer, N 2Lt Timothy A Gileen, IBO SSgt Steven L Metts

320 BMW, Mather Crew E-103: AC Maj Roger L Camp, CP 1Lt David P Lawlor, NN Capt David R McCarthy, BO SSgt John W Oglesby

320 BMW, Mather Crew S-31: AC Capt Louis R Bailey, CP 1Lt John L Wright, RN Maj James R Thomits, NN 1Lt Barry D Walters, EW 1Lt Ranier G Gomez, AG A1C Scott E Lynch

351 SMW, Whiteman Crew E-050: MCCC 1Lt John J Muller, DMCCC 2Lt John L Donovan

381 SMW, McConnell Crew S-224: MCCC Capt Daniel P Moore, DMCCC Capt Robert L Robinson, MSAT TSgt David E Poorman, MFT SSgt Charles J Bibeau

308 SMW, Little Rock Crew R-030: MCCC Capt Montoria Hubbard, DMCCC 1Lt Gerald R Violette, MSAT Sgt Paul J Kromer, MFT SSgt John D Teeman

321 SMW, Grand Forks Crew R-122: MCCC 1Lt Christopher L Taylor, DMCCC 2Lt Patrick E Lite

44 SMW, Ellsworth Crew E-170: MCCC Capt Stanley Jones, DMCCC 2Lt Terry Carver

509 BMW, Pease Crew E-28: P Capt Steven D Brashear, P Capt Michael J McElwee

509 BMW, Pease Crew E-16: P Capt Robert B Thompson, RN Capt Joseph E Hughes

509 BMW, Pease Crew E-24: P Capt Alexis P Kister, RN Maj James D Kotton

509 BMW, Pease Crew E-11: P Maj Al Pickering, P Capt David Gibbs, RN Maj Luke Lu

91 AREFS, McConnell Crew E-105: P Capt Scott L Wagner, CP 1Lt Aaron A Bowen, N 1Lt John R Roberts, BO SSgt Yvonne O Wherry

384 AREFS, McConnell Crew R-160: P Capt Jeffrey S Antes, CP 2Lt Glenn M Ewton, N Capt Jim S McCready, IBO SSgt Joel D Estes

380 AREFS, Plattsburgh Crew E-130: P Capt Geoffrey C Doherty, CP Capt John F Connors, N Capt Dana N Willis, BO TSgt Roger Barrett

380 AREFS, Plattsburgh Crew E-122: P Capt Andrew L Giacomini, CP Capt Thomas J Martin, N Capt Dorilynn D Gimondo, BO A1C Jeffrey L Magee

380 AREFS, Plattsburgh Crew S-110: P Maj Theodore B Price Jr, CP Capt Edward J Valickus, N Capt Sheri W Andino, BO SSgt James A Bullock Jr

11 AREFS, Altus Crew R-123: P Capt Debra L Terry, CP 2Lt Walter R Byrd, IN Capt Robert G Cunningham, BO A1C Eddie F Dean

306 AREFS, Altus Crew R-171: P Capt Anthony J Merluzzi, CP Capt Harry Schulz, IN Capt Vance S Alm, IBO SSgt Joseph Surovy

305 AREFS, Grissom Cew E-121: P Capt Martin H Breidenstein, CP 1Lt Douglas J McHugh, N 1Lt Bonifacio Hernandez III, BO Sgt Verl T Palmer

305 AREFS, Grissom Crew R-124: P Capt Steven W Beenck, CP 1Lt Walter R Bragagnolo, N 1Lt Mark H Bradwick, BO TSgt Rick W Dayton

7 AREFS, Carswell Crew R-125: P Capt Norris D Shane, CP 1Lt Fletcher M Cooper, N 1Lt Raymond J Rottman, BO A1C Richard A Brack

9 BMS, Carswell Crew E-76: P Capt Jeffrey W Ray, CP 1Lt Charles W Norton, RN Capt Grover M Gossett, N 1Lt Gregory A Harbin, EW 1Lt Daniel M Yancy, G A1C Peter A White

20 BMS, Carswell Crew E-44: P Maj Robert C Luther, CP Allan F Cobb, RN Capt Julio R Sotomayor, N 1Lt Kevin Stafford, EW Capt Thomas Lester, G Sgt Eugene L Hodges III

UNIVERSITY OF FLORIDA
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HALL OF FAME

OVER THIRTY YEARS

170 AREFG, McGuire (NJANG)	Feb. '56

OVER TWENTY-EIGHT YEARS

171 AREFW, Greater Pittsburgh (PAANG)	Mar. '58
157 AREFG, Pease (NHANG)	Jun '58

OVER TWENTY-SEVEN YEARS

940 AREFG, Mather (USAFR)	May '59

OVER TWENTY-FIVE YEARS

151 AREFG, Salt Lake City (UTANG)	Feb. '61
134 AREFG, McGhee Tyson (TNANG)	Aug. '61

OVER TWENTY-FOUR YEARS

11 SG, Fairford	Feb '62
340 AREFW, Altus	Jun '62
96 BMW, Dyess	Aug. '62

OVER TWENTY-ONE YEARS

160 AREFG, Rickenbacker (OHANG)	Dec. '64
320 BMW, Mather	Jul '65

OVER NINETEEN YEARS

452 AREFW, March (USAFR)	Sept '66
55 SRW, Offutt	Jul '67
2 BMW, Barksdale	Aug '67

OVER SEVENTEEN YEARS

5 BMW, Minot	Feb. '69

OVER SIXTEEN YEARS

141 AREFW, Fairchild (WAANG)	Oct '69
28 BMW, Ellsworth	May '70

OVER FOURTEEN YEARS

101 AREFW, Bangor (MEANG)	Mar '72
306 SW, Mildenhall	Apr '72
416 BMW, Griffiss	May '72

OVER THIRTEEN YEARS

379 BMW, Wurtsmith	Apr '73

OVER TWELVE YEARS

931 AREFG, Grissom (USAFR)	Feb '74
384 AREFW, McConnell	Mar '74
189 AREFG, Little Rock (ARANG)	May '74

OVER ELEVEN YEARS

43 SW, Andersen	Dec '74

OVER TEN YEARS

68 AREFG, Seymour Johnson	Sep '75

OVER NINE YEARS

410 BMW, K.I. Sawyer	Apr '77
190 AREFG, Forbes (KSANG)	Apr '77
128 AREFG, Milwaukee (WIANG)	Jul '77

OVER SEVEN YEARS

376 SW, Kadena	Aug '79

OVER SIX YEARS

7 BMW, Carswell	Jul '80

OVER FIVE YEARS

319 BMW, Grand Forks	Sept '80
380 BMW, Plattsburgh	Oct '80
97 BMW, Blytheville	Jan '81

OVER FOUR YEARS

22 AREFW, March	Oct '81

ICBM

OVER TWENTY-ONE YEARS

1 STRAD, Vandenberg	Sept '64

OVER FOURTEEN YEARS

321 SMW, Grand Forks	Aug '72

OVER ELEVEN YEARS

351 SMW, Whiteman	Oct '74
91 SMW, Minot	Nov '74

OVER EIGHT YEARS

381 SMW, McConnell	Aug '78

OVER SEVEN YEARS

44 SMW, Ellsworth	Nov '78

OVER SIX YEARS

90 SMW, F.E. Warren	Dec '79

OVER FIVE YEARS

308 SMW, Little Rock	Sept '80

To gain listing in the Hall of Fame, a SAC or ARF unit must be Class A mishap-free for 48 months.